

[0001] ROBOTICALLY PLACED AND FORMED MAGNETIC
ADHESIVE GASKETS

[0002] CROSS REFERENCE TO RELATED APPLICATION

[0003] This application claims the benefit of U.S. Provisional Patent Application No. 60/418,495, filed October 15, 2002, which is incorporated by reference herein as if fully set forth.

[0004] BACKGROUND

[0005] The present invention relates to a gasket structure for providing a seal between a door and a surrounding structure, and in particular provides an improved refrigerator or freezer door gasket.

[0006] Refrigerator/freezer door gaskets are typically attached via physical means to refrigerator/freezer doors. The gaskets adhere to the opposing refrigerator door opening frames when the door is closed by magnetic strips contained within gasket systems.

[0007] Such gaskets typically include a base formed of a semi-rigid thermoplastic elastomer material that can be secured to the inner surface of the door around the periphery where the door faces the door opening frame. A jacket formed of a flexible thermoplastic elastomer material having a flexible bellows-like structure extends from the base and a magnetic strip is located therein. As the door closes, the gasket magnetically engages a selected part of the door opening frame to form a seal and the flexible bellows-like structure allows a predetermined amount of extension and/or compression of the magnetic sealing gasket so that a complete contact between the gasket and frame is achieved. This provides an effective thermal and/or hermetic seal between the door and the frame.

[0008] However, the door gaskets and magnetic inserts are formed through

different processes, typically at different locations, and due to the complex shape and rigid form of the completed gasket assembly, transportation of the gasket is both cumbersome and significantly expensive.

[0009] SUMMARY

[0010] The present invention provides a novel gasket for sealing an appliance door and a method for forming the novel gasket on a suitable surface.

[0011] In one embodiment, the gasket includes magnetic gasket material attached by an adhesive to an appliance door shell or removable panel. The gasket material forms a pair of sealing lips which provide the necessary configuration to releasably engage a mating door jamb when the door shell is in a closed position. The magnetic gasket material may be an RTV (room temperature vulcanizing) sealant, or other suitable elastomer, with a mixed-in magnetizable material such as ferrite and/or rare earth powder.

[0012] In another embodiment the gasket includes a magnetic strip or wire covered by formed-in-place gasket material. An adhesive or an adhesion promoter is used to attach the magnetic strip to the gasket material, and to attach both the gasket material and the magnetic strip to the door shell.

[0013] Other embodiments employ the above configurations and additionally provide perforations in the door shell. Portions of the gasket material protrude through the perforations providing an anchor for the gasket.

[0014] A method for forming the above embodiments includes the steps of applying a continuous length of form-in-place gasket material on the door shell and curing the gasket material. Adhesion promoters or adhesives may be applied to connect the gasket material to a magnetic strip or connect the gasket to the door shell. Also, providing a door shell having perforations allows the form-in-place gasket material to flow through the perforations during application to create an anchor after curing.

[0015] BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Figure 1 is a cross-sectional view of a V-shaped gasket mounted on an appliance door in accordance with the present invention.

[0017] Figure 2 is a cross-sectional view of the V-shaped gasket of Figure 1, shown with the appliance door in a closed position.

[0018] Figure 3 is a cross-sectional view of a V-shaped gasket mounted on an appliance door according to another embodiment of the invention.

[0019] Figure 4 is a cross-sectional view of a tongue-and-groove-shaped gasket mounted on an appliance door in accordance with the present invention.

[0020] Figure 5 is a cross-sectional view of the tongue-and-groove-shaped gasket of Figure 4, with the appliance door in a closed position.

[0021] Figure 6 is a cross-sectional view of a formed-in-place gasket, which contains a magnetic strip, mounted on an appliance door in accordance with the present invention.

[0022] Figure 7 is a cross-sectional view of a second embodiment of a formed-in-place gasket containing a magnetic strip according to another embodiment of the invention.

[0023] Figure 8 is a cross-sectional view of a third embodiment of a formed-in-place gasket containing a magnetic strip in accordance with the present invention.

[0024] Figure 9 is a perspective view showing the formation of a gasket on an appliance door according to the present invention.

[0025] Figure 10 is a perspective view showing the formation of a gasket on a flat panel according to the present invention.

[0026] Figure 11 is a perspective view showing the formation of a gasket on a curved panel according to the present invention.

[0027] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] Figure 1 shows a cross-sectional view of a gasket 10 in accordance with the present invention adhered to a door shell 20. The gasket 10 is formed of a

magnetic gasket material, such as an FDA approved RTV sealant with a mixed in magnetic or magnetizable material. The magnetic or magnetizable material may be a ferrite powder, or alternatively, a rare earth powder such as neodymium-iron-boron. In addition to RTV sealant, other suitable elastomers which may be ambient, heat or UV cured may also be used. The gasket 10 has two sealing lips 11, 12, separated by a gasket well 13. The size of the lips 11, 12, and the size of the well 13 compared to the size of the gasket 10 are dependent on several variables. These variables include the dimensions of the appliance, the separation between the door and the door jamb, the required force needed to maintain the seal, the flexibility of the gasket material, as well as other variables such as aesthetic considerations.

[0029] As shown in Figure 1, the gasket 10 can be attached to the door shell 20 by an adhesive 15. Such adhesive can be placed on to the door shell prior to forming the gasket in place, or the gasket material itself may have sufficient adhesive properties to affix itself to the door shell 20. The sealing lips 11 and 12 may be symmetric or asymmetric depending on the particular application.

[0030] The door shell 20 is preferably part of a hinged door, or alternatively part of a non-hinged panel, such as an appliance outer shell, removable for cleaning, repair or replacement. The door shell 20 may be constructed of any structurally suitable material, magnetic or non-magnetic, including glass, metal, ceramics, or plastics. Alternatively, the gasket 10 may be provided on the surface of any article such that the article may be removably affixed to a magnetic surface for storage or display. For example, a kitchen article such as a bread board, serving tray, or the like may be temporarily affixed to the steel panel of a refrigerator, stove, or other appliance.

[0031] Figure 2 shows the door shell 20 being in a closed position with the gasket 10 forming a tight seal between the door shell 20 and a door jamb 40 which presents interfacing surfaces 21,41. The door jamb 40 may be a part of a refrigerator or freezer cabinet or door opening frame, or alternatively, may define an opening or placement area for any type of removable panel, hinged or unhinged, functional or decorative. The door jamb 40 is made out of a magnetic material that is attracted to magnetic

material of the gasket 10. The lips 11 and 12 are sealed magnetically to the door jamb surface 41.

[0032] Another embodiment of the present invention is shown in Figure 3. In this embodiment the door shell 20 is not a continuous, monolithic body, but has perforations 60 along the area where the gasket 10 is to be formed. Such perforated holes 60 may be in any shape that would allow the forming matrix of the gasket material to flow during the formation stage through the holes 60 and form an anchor portion 50 on the other side of the perforations 60. The perforations 60 are large enough to allow sufficient amount of material to flow through to hold the gasket 10 in place, but do not weaken the structure of the door shell 20. The perforations 60 may have any profile including, but not limited to, circular, oblong, elliptical, mesh, square, rectangular, hexagonal, triangular, etc. The advantage of this embodiment, as shown in Figure 3, is that the gasket is held in place mechanically, thus it will reduce the possibility of adhesion or cohesion failure between the gasket 10 and the door shell 20. The sealing of the door shell 20 to the door jamb by the gasket 10 according to embodiment as shown in Figure 3 will perform in a similar manner as the gasket shown in Figure 1.

[0033] An alternative embodiment of the gasket 10 is shown in Figure 4. In this embodiment, the gasket 110 does not have a V-shape like the gasket 10 shown in Figure 1, but rather has a tongue and groove configuration. The surfaces of the lips 111 and 112 adhere to the door jamb in such a way to create an air sealed junction. The surfaces of the lips 111, 112 may be parallel to the surface 21 or they may be sloped to mirror the surfaces on the door jamb. The gasket 110 also contains a tongue 113 located between the lips 111 and 112. This tongue 113 fits into a groove 123 of the door frame 140, as shown in Figure 5. The geometry of the groove 123 should be such that air trapped between the tongue 113 and groove 123 is able to escape to form a tight seal, but does not allow any air to ingress after sealing. The two lips 111 and 112 are not necessarily symmetric. One of them may be longer, thicker, or a combination of the two, than the other.

[0034] It is also possible to form gasket 110 in a similar manner to that shown in Figure 3: namely, such a gasket may be formed on a door shell that has perforations, thus allowing the gasket matrix to extend through the appropriate perforations to form an anchor, thus assuring that the gasket is attached to the door shell material by mechanical means and not by adhesive 115 as shown in Figure 4.

[0035] A gasket 210 in accordance with another embodiment of the present invention is shown in Figure 6. The gasket 210 is comprised of a strip of magnetic material 270 which is covered by a formed-in-place gasket material 272. Adhesive layers or adhesion promoters 280, 282 may be utilized, if necessary, to assist in bonding the materials together and to the door 20. The gasket 210 may have any geometry, as long as it forms a good seal between the door shell and door jamb. The embedded magnetic material 270 may be a single strip of magnetic material, or it may be a plurality of strips. Furthermore, the magnetic material may take any geometric shape, as long as its presence contributes to the sealing of the door shell to the door jamb.

[0036] An alternate embodiment of the gasket 310 in accordance with the invention is shown in Figure 7. In this embodiment, door shell 20 includes perforations 60. The magnetic strip 270 is placed on the shell 20 in such a way that the perforations 60 can be found on either side of the magnetic strip 270. After the magnetic strip 270 is in position, the gasket material is formed in place. The gasket material extends through the perforations 60, so that an anchor portion 350 is formed on the other side of the door shell, to hold the gasket 310 in place.

[0037] It is understood that the surfaces of the gaskets 210 and 310 are not necessarily parallel to the door jamb surface. It is possible for this surface to have other geometric features such as sealing lips, tongue and groove features, either singly or in a plurality of formations. It is recognized, that it is not necessary that the thickness of the gasket to be very great. For example, in order to increase the effectiveness of the sealing mechanism due to the magnetic attraction of magnet 270 to the door jamb, the thickness of the gasket material over the magnet 270 may be

rather small. Alternatively, the strength of the magnet 270 can be adjusted based on the thickness of the gasket.

[0038] Another embodiment of the gasket 410 in accordance with the present invention is shown in Figure 8. In this embodiment, the door shell 220 has a well 222 into which magnetic material 270 is placed. After placement of the magnetic material into the well 222, the gasket material is formed in place to form the magnetic gasket 410. An adhesive or adhesion promoter 415 can be used between the gasket material and the door and/or magnet 270. It is possible that the magnetic material 270 is adhered via adhesive in the well 222. Like the gasket 310, the surface of gasket material 410 need not be flat. It is possible, that the surface is comprised of several geometric features such as sealing lips, tongue and groove features, etc.

[0039] Another aspect of this invention is the process of making a refrigerator door assembly or other flat panel or component that requires a seal. As shown in Figure 9, an in-place forming apparatus that dispenses or extrudes the form-in-place gasket material is located along the factory line. A partially formed refrigerator or freezer door 600 comprised of an outer shell 601 and inner liner 602 is located in desired positions adjacent to a dispensing head 500 that extrudes or dispenses the form-in-place material 610 used to form the gasket. This can be extruded with the desired shape, or may be otherwise formed with the magnetic material mixed in with the gasket forming elastomer. While a refrigerator door is shown in Figure 9, the form-in-place material 610 could be applied to a simple flat panel 700, as shown in Figure 10, or even a curved panel 800, as shown in Figure 11. The flat and curved panels 700, 800 may be representative of fascias, doors, covers or basic household articles requiring a permanently magnetized surface.

[0040] After the gasket is formed it is magnetized and cured on the assembly line. Alternatively, it can be preformed and/or premagnetized. An advantage of the use of present technology is that it is possible to form the gaskets on site, and preferably in place on glass or plastic surfaces and/or on non-assembled frames and/or doors, thus eliminating the costly shipping of voluminous gaskets as well as additional

handling. Additionally, multiple components are not required from different locations, and labor costs for assembly are avoided. A further advantage is the easy formation of custom-made gaskets to any desired size and with custom colors.

[0041] The coloring of gaskets can be performed by addition of coloring agents into the gasket mixture. The colorants should be of stable nature so they do not decompose under everyday conditions in a residential setting.

[0042] Each of the above embodiments describes a gasket permanently connected to an appliance door shell. However, those skilled in the art recognize that gaskets of the types described may be permanently connected to any suitable surface including an appliance door jamb.

[0043] While the preferred embodiment of the invention has been described in detail, the invention is not limited to the specific embodiment described above, which should be considered as merely exemplary. Further modifications and extensions of the present invention may be developed, and all such modifications are deemed to be within the scope of the present invention as defined by the appended claims.

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